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ANCHOR QEA

Memorandum

August 2, 2017

To: Bob Wyatt, NW Natural

From: Amy Nelson and Taku Fuji, Anchor QEA, LLC

cc: Patty Dost, Pearl Legal Group

Ryan Barth, Carl Stivers, and Ben Hung, Anchor QEA, LLC

Re: USEPA Updates to Human Health Toxicity Values for Benzo(a)pyrene and Potential Effects on Cleanup Levels and Remedial Action Levels in Portland Harbor

Introduction

This memorandum summarizes the January 2017 U.S. Environmental Protection Agency (USEPA) updates to the human health toxicity values for benzo(a)pyrene (BaP) and their potential impacts on cleanup levels and remedial action levels (RALs) identified in the January 3, 2017 Record of Decision (ROD; USEPA 2017a) at the Portland Harbor Superfund Site (Site). USEPA's January 19, 2017 updates to *Toxicological Review of Benzo(a)pyrene (CASRN 50-32-8): Executive Summary. Integrated Risk Information System (IRIS)* (USEPA 2017b) include the following toxicity value changes:

- The oral cancer slope factor (CSF) decreased from 7.3 per milligram per kilogram-day (per mg/kg-day) to 1 per mg/kg-day. In general, the use of a lower BaP CSF results in lower BaP and carcinogenic polycyclic aromatic hydrocarbon (cPAH) risk estimates.
- A non-cancer oral reference dose (RfD) of 0.0003 per mg/kg-day was added; previously, USEPA did not identify an RfD for BaP in IRIS. Thus, BaP non-cancer risks had not been previously estimated.

Cleanup Levels

USEPA calculated preliminary remediation goals (PRGs) in the *Portland Harbor Feasibility Study* (FS; USEPA 2016) for each remedial action objective (RAO). In the ROD, USEPA set cleanup levels by media using the PRGs from the FS. Sediment and riverbank soil cPAH cleanup levels (expressed as BaP equivalents) presented in the ROD are based on PRGs developed using the 1987 BaP CSF (representing $1x10^{-6}$ risk level), rather than the 2017 BaP CSF.

This technical memorandum recalculates the cPAH PRGs presented in the FS and ROD using the new BaP CSF.[1] We have not modified any other variable or USEPA's equations themselves.

[1] USEPA cleanup levels (and RALs) incorporate rounding in one or more steps in the calculation, so recalculated concentrations are approximate.

Nearshore Sediment Cleanup Levels

The "riverbank soil/sediment" nearshore sediment cleanup level for cPAH of 12 micrograms per kilogram (µg/kg), as presented in Table 17 of the ROD (USEPA 2017a), is the minimum amount of cPAH PRGs by media developed in the FS and represents the human health sediment direct contact pathway specific to beaches. The USEPA FS also includes a separate RAO 1 cPAH PRG of 106 µg/kg for the sediment direct contact exposure evaluated in the Baseline Human Health Risk Assessment (BHHRA) for nearshore areas (i.e., outside the channel and not at beaches; identified in the FS as "in-water" PRGs). Although ROD Table 17 does not include that in-water value and defaults to the lower 12-µg/kg value based on beach exposures, the 106-µg/kg PRG is used to define "highly toxic" principal threat waste (PTW) concentrations in the ROD and to evaluate risk reduction for USEPA's selected remedy (USEPA 2017a, Table 6 and Appendix IV, Table J.2.2-1c).

If the updated BaP CSF was applied, the cleanup level based on the RAO 1 direct contact PRG applicable to beaches would increase from 12 µg/kg to approximately 85 µg/kg. The risk-based PRG for beach contact (recreational beach user) presented in the ROD is a cancer-based goal that happens to be the same number as the background value (a value USEPA estimated using a total polycyclic aromatic hydrocarbon [TPAH] to cPAH regression equation). Therefore, the updated BaP cleanup level of 85 µg/kg would lead to the risk-based goal being greater than USEPA's background value.

Using the updated BaP CSF, the cPAH RAO 1 in-water sediment direct contact PRG (based on cancer risks for the tribal fisher and applicable to nearshore sediments outside beach areas) would increase from 106 µg/kg to approximately 773 µg/kg.

Navigation Channel Sediment Cleanup Levels

Per USEPA's ROD Table 17 footnote (USEPA 2017a), the cPAH cleanup level of 3,950 µg/kg for navigation channel sediment is based on the RAO 2 sediment PRG protective of clam consumption by humans. Applying the updated BaP CSF to USEPA's cPAH clam PRG equation (USEPA FS Appendix D, as updated in the ROD), the resulting sediment cleanup level would increase from 3,950 µg/kg to approximately 108,000 µg/kg. Due to the log-log biota-sediment accumulation regression equation used in developing this PRG, the increase is not directly 7.3-fold as it is for the sediment direct contact PRGs applied for nearshore sediments.

Surface Water Cleanup Levels

Surface water cleanup levels in the ROD were selected based on the lower of RAO 3 and 7 PRGs from the FS (USEPA 2016). The ROD surface water cleanup level for cPAH (0.00012 µg/L) is equivalent to the RAO 3 PRG, which is based on federal human health water quality criteria protective of fish consumption. This value is lower than the RAO 7 ecological-based value for BaP (0.014 µg/L).

Application of USEPA's updated CSF would affect both the Oregon and federal human health water quality BaP criteria. The updated BaP CSF would increase the federal criteria and therefore, the ROD surface water cleanup level for BaP from 0.00012 µg/L to approximately 0.0009 µg/L. Similarly, the Oregon criteria would increase from 0.0013 µg/L to 0.0095 µg/L. Per the current ambient water quality criteria document for BaP (USEPA 2015), USEPA planned to update the human health criteria for BaP following the finalization of the IRIS update.

USEPA's No Action site-wide average surface water cPAH concentration (approximately 0.0008 µg/L, per ROD Appendix IV Figure 4.2-8b provided in the ROD [USEPA 2017a]) is less than the revised surface water cleanup level of 0.0009 µg/L. Following USEPA's FS evaluation methods, this would mean that the site already achieves the revised cleanup level.

Non-cancer PRGs

Prior to the BaP toxicity value update, a USEPA-approved non-cancer RfD did not exist for BaP and, as such, non-cancer hazards were not quantified in the Site human health risk assessment for BaP (Kennedy/Jenks Consultants 2013). However, USEPA apparently used this new toxicity value[2] to develop non-cancer RAO 1 PRGs for cPAH (FS Table B3-4; USEPA 2017a). These PRGs were not summarized in USEPA FS Section 2 and do not appear to be used in the FS or ROD evaluations. Because cPAH is a chemical sum made up of specific carcinogenic PAHs, it is unclear whether USEPA intended these PRGs to be applied to cPAH or only to BaP. However, the non-cancer cPAH RAO 1 PRGs in Table B3-4 of the USEPA FS are orders of magnitude higher than the cancer-based RAO 1 PRGs (i.e., the minimum non-cancer cPAH PRG is 91,470 µg/kg).

Remedial Action Levels and Principal Threat Waste Highly Toxic Threshold

The selected remedy identified in the ROD (USEPA 2017a) includes RALs and PTW highly toxic sediment concentrations, above which USEPA's remedy requires active remediation. PAH RALs for sediment identified in USEPA's ROD are TPAH concentrations determined by USEPA using RAL curves, the cPAH to TPAH correlation regression analysis, and USEPA's professional judgment regarding the acceptability of surface-weighted average concentrations (SWACs) achieved relative to various PRGs. Therefore, revised RALs cannot be directly recalculated using the updated BaP CSF. Nonetheless, USEPA's RAL determination methods can be mimicked using the updated PRGs through two approaches: 1) a proportional adjustment approach; and 2) a risk-reduction approach.

For the first approach, we used USEPA's correlation relationship between cPAH PRGs and TPAH RALs to estimate revised RALs. For the second approach, we also used post-construction SWACs associated with various RALs and compared them to the revised PRGs to see if higher RALs would

[2] Though USEPA cites the RfD as a 2004 number, it did not exist at that time, and it was not used in the baseline human health risk assessment.

still meet USEPA's interim target risk levels, similar to USEPA's FS methods for post-construction risk estimation. Each of these approaches are detailed below.

Nearshore Sediment RAL

The selected remedy identified in the ROD includes a TPAH RAL of 13,000 µg/kg applicable to nearshore sediments. The ROD cleanup levels associated with the nearshore sediment direct contact include 23,000 µg /kg TPAH (RAO 5 benthic risk PRG) and 12 µg/kg cPAH (RAO 1 beach direct contact PRG). As noted above, USEPA identifies the sediment direct contact PRG for beach sediments as the cleanup level for RAO 1, which is inconsistent with the RAO 1 exposure scenario evaluated in the BHHRA for nearshore sediments outside of beach areas. However, USEPA developed the TPAH RALs based upon the 106-µg/kg cPAH PRG (USEPA 2016, Figure 3.4-2). Further, USEPA's updated calculation of residual and post construction risks (USEPA 2017a, Appendix IV, Appendix J) evaluates achievement of RAO 1 in nearshore sediments for each alternative, including the selected alternative, using the in-water sediment RAO 1 cPAH PRG of 106 µg/kg. Consequently, we used the same PRG for our revised RAL estimates.

Proportional Adjustment Approach

The ROD TPAH RAL of 13,000 µg/kg converts to 1,500 µg/kg cPAH using USEPA's cPAH to TPAH regression, which is approximately 14 times the USEPA's RAO 1 in-water sediment cPAH PRG of 106 µg/kg. Proportionally adjusting USEPA's RAL by applying a 14-fold increase to the revised RAO 1 in-water cPAH PRG (773 µg/kg) results in an estimated revised RAL for the nearshore of 92,000 µg/kg TPAH (converted from 10,800 µg/kg cPAH using the regression and rounding to two significant figures, consistent with USEPA's RALs).[3] Figure 1 shows the sediment management areas (SMAs) associated with an alternative where the only modification to the selected remedy is revision of the nearshore TPAH RAL from 13,000 µg/kg to 92,000 µg/kg. Total SMA acreage (areas exceeding all RALs plus all PTW) decreases from 355 acres for the selected remedy (red area) to 326 acres (yellow plus green areas). Though the proportionally adjusted nearshore TPAH RAL results in only an approximately eight percent decrease in total SMAs, the revised RAL primarily reduces the SMA extents upstream and downstream of Gasco (only in the nearshore area, which is where the revised RAL would be applied).

[3] TPAH RAL for the nearshore sediments is 125 times the USEPA's RAO 1 beach PRG. Proportional adjustment results in a revised cPAH RAL of 10,600 µg/kg (approximately 91,000 µg/kg TPAH).

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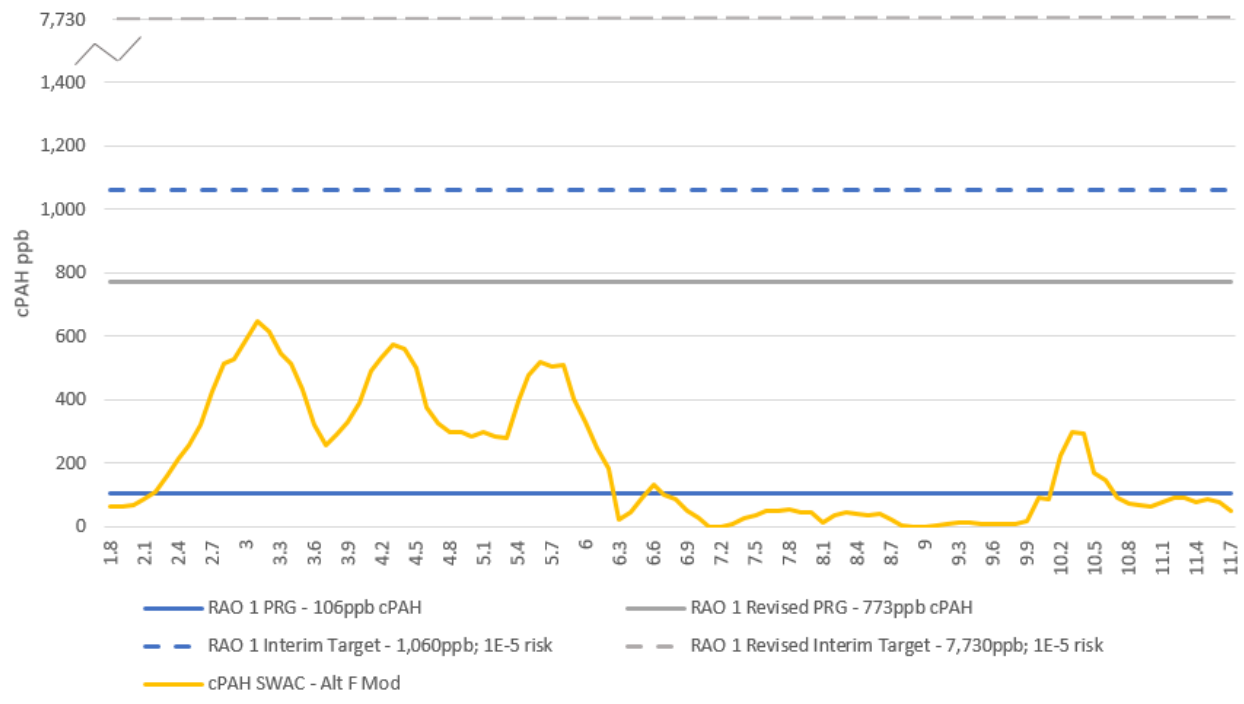
Figure 1
Sediment Management Areas (SMAs) Using Revised Nearshore TPAH RAL
Portland Harbor Record of Decision Review
Gasco Sediments Cleanup Action

Risk Reduction Approach

PRGs were developed at a $1x10^{-6}$ level (USEPA 2016). USEPA set interim targets for risks to evaluate the potential for achievement of PRGs in a "reasonable time frame." For RAO 1, USEPA set the interim target at $1x10^{-5}$ cumulative risk (i.e., the total risk of the contaminants of concern evaluated in USEPA's FS). Therefore, risk reduction from cPAHs for river miles (RMs) where cPAHs compose most of the cumulative risk can be used to develop a revised TPAH RAL, and an interim target-based concentration was estimated from the revised cPAH PRG. These evaluations are discussed below, with a focus in this example on the west side of the river where, according to USEPA's ROD, cPAHs compose most of the cumulative risk in select RMs.

USEPA's selected remedy (Alternative F Modified) in the ROD contains several RM SWACs (as reported in the USEPA FS Appendix J tables provided in the ROD) that exceed USEPA's RAO 1 in-water direct contact cPAH PRG (Figure 2) but meet the interim target at a cancer risk level of $1x10^{-5}$. When the revised PRG is used, all RM SWACs associated with USEPA's selected remedy are less than the revised PRG and much less than the revised $1x10^{-5}$ interim target level.

Figure 2
USEPA-selected Remedy Post-construction cPAH SWACs Using USEPA App J 0.5 RM SWACs – West

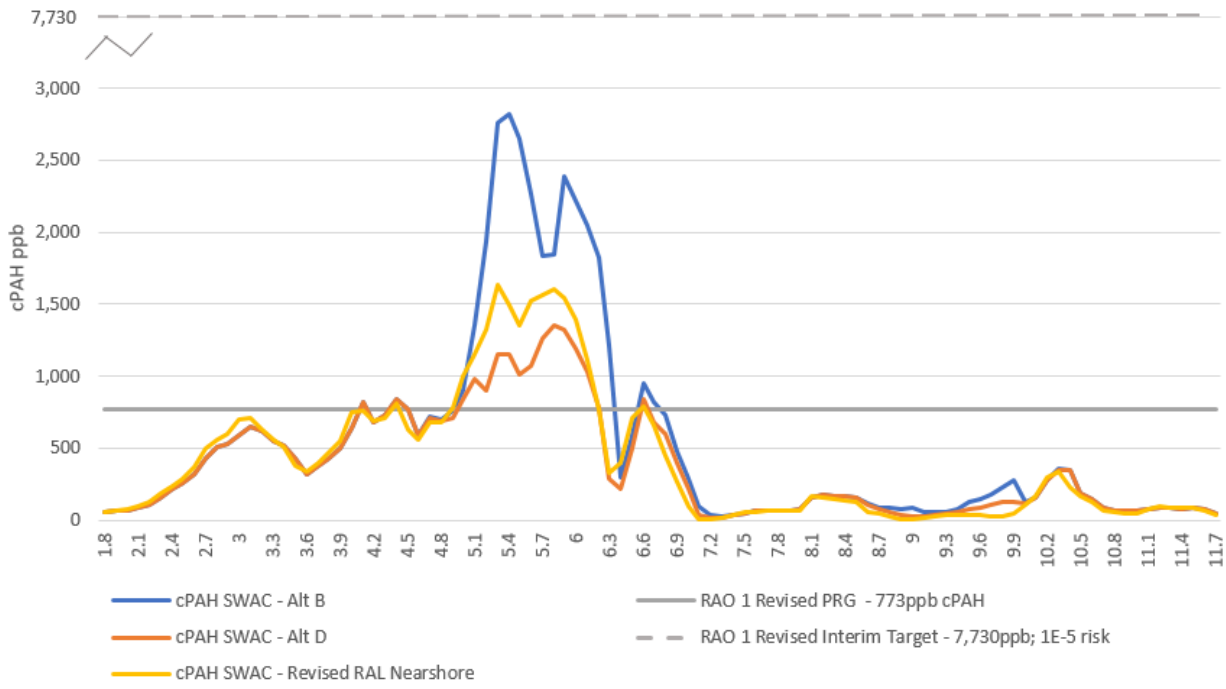


To identify which RAL could be applied and still meet USEPA's interim targets, post-construction SWACs were compared to the revised PRG and interim target level using USEPA's Appendix J SWACs (based on rolling 0.5 RM segments) for Alternatives B and D and Anchor QEA-estimated SWACs for the estimated RAL based on proportional adjustment

As shown in Figure 3, USEPA's Alternative B (RAL of 170,000 µg/kg) meets the revised PRG in most RMs. Similar to USEPA's Alternative D, revision of the nearshore TPAH RAL from 13,000 µg/kg to 92,000 µg/kg results in estimated post-construction SWACs that achieve the revised PRG at more RMs than for Alternative B. All SWACs in Figure 3 are well below the revised interim target.

Based on these SWACs and the revised RAO 1 in-water direct contact cPAH PRG applicable to nearshore sediments (773 µg/kg), a revised TPAH RAL for nearshore sediment that would likely meet USEPA's objectives for risk reduction could increase from 13,000 µg/kg to a range of 92,000 µg/kg to 170,000 µg/kg, a 7- to 13-fold increase.

Figure 3
Post-construction cPAH SWACs Using USEPA App J 0.5 RM SWACs Revised RAL – West



Navigation Channel Sediment RAL

USEPA's selected remedy in the ROD includes a TPAH RAL of 170,000 µg/kg applicable to navigation channel sediments. The cleanup levels associated with the navigation channel include 23,000 µg/kg TPAH (RAO 5 benthic risk PRG) and 3,950 µg/kg cPAH (RAO 2 PRG). As described above, the RAO 2

cPAH cleanup level increases to 108,000 µg/kg using the revised CSF. Potential impacts to the navigation channel TPAH RAL from application of the revised RAO 2 cPAH cleanup level are summarized below.

Proportional Adjustment Approach

The ROD TPAH RAL of 170,000 µg/kg converts to approximately 20,000 µg/kg cPAH using USEPA's cPAH to TPAH regression, which is approximately five times the ROD RAO 2 cPAH cleanup level. Proportionally adjusting USEPA's RAL by applying a five-fold increase to the revised RAO 2 cPAH cleanup level (108,000 µg/kg) results in an estimated revised RAL for the navigation channel of 540,000 µg/kg cPAH (more than 4,000,000 µg/kg TPAH).

Risk Reduction Approach

The revised RAO 2 cPAH cleanup level (108,000 µg/kg) exceeds the ROD cPAH PTW highly toxic threshold (106,000 µg/kg). USEPA's No Action SWACs for all RMs in the navigation channel (per the USEPA ROD, Appendix IV, Appendix J tables) already achieve the revised RAO 2 cPAH cleanup level. Therefore, a TPAH RAL would no longer be needed to be protective of the revised PAH human health cleanup level.

Revised SMAs associated with applying a revised nearshore TPAH RAL of 92,000 µg/kg and eliminating a navigation channel TPAH RAL are shown in Figure 4 as compared to the SMAs associated with USEPA's selected remedy. The RAL revisions eliminate nearly all SMAs in the navigation channel; those remaining are associated with elevated PCB concentrations (green areas). Total SMA extents decreases by approximately 14 percent from 355 acres associated with USEPA's selected remedy to 304 acres through revising nearshore and navigation channel TPAH RALs. The TPAH areas associated with Alternative B (blue areas) are included for comparison with the TPAH areas associated with the revised nearshore and navigation channel RALs (yellow areas).

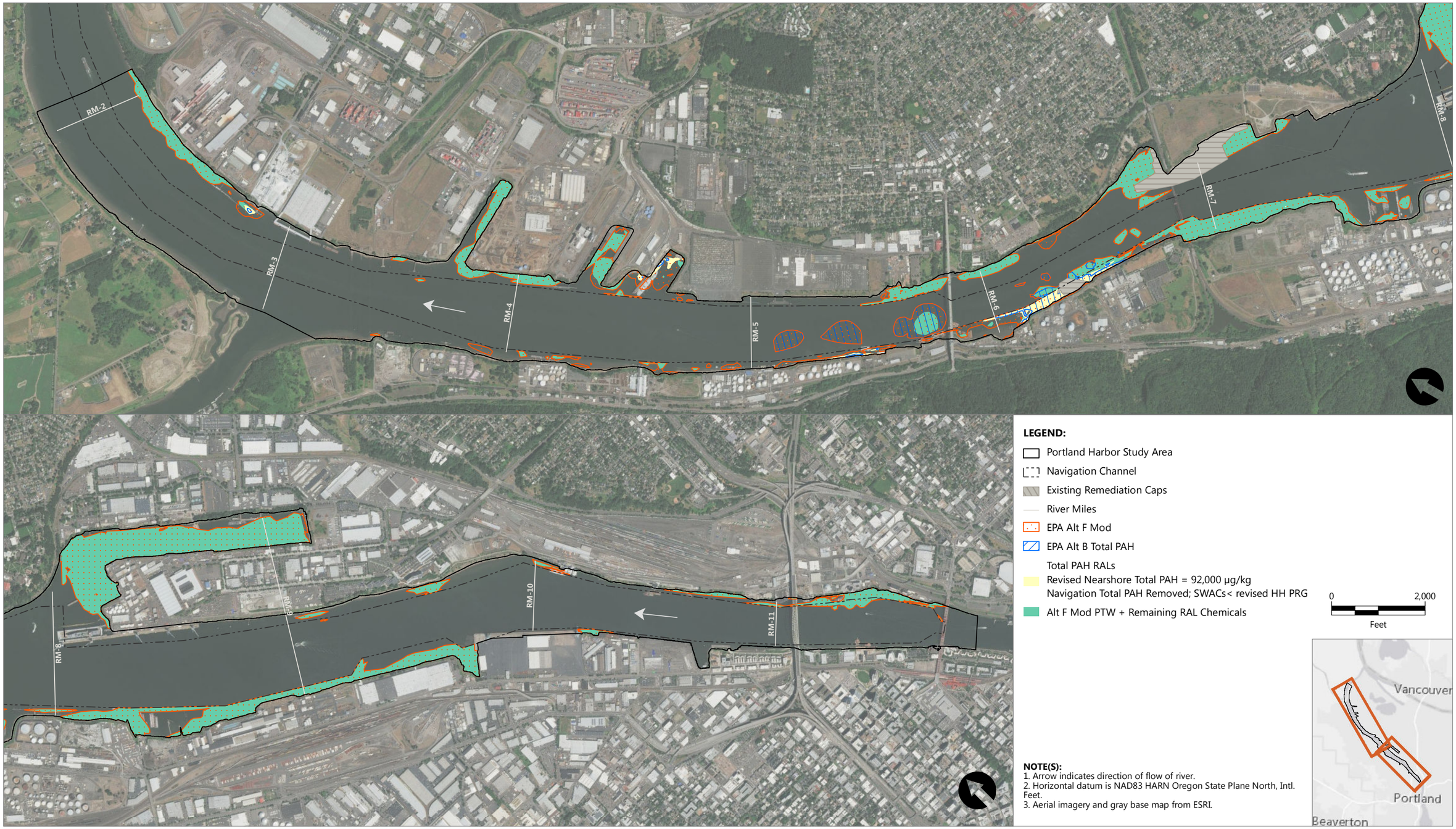


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Figure 4
Sediment Management Areas (SMAs) Using Revised Nearshore and Navigation Channel TPAH RALs
Portland Harbor Record of Decision Review
Gasco Sediments Cleanup Action

Principal Threat Waste

PTW highly toxic is a risk-based action level based on the RAO 1 in-water direct contact cPAH PRG; therefore, a revised threshold can be calculated following USEPA's methods using the revised BaP CSF. The PTW highly toxic cPAH concentration increases from 106,000 µg/kg to 773,000 µg/kg when applying the new BaP CSF. USEPA's No Action sediment concentrations are less than this revised PTW highly toxic threshold; therefore, no PTW highly toxic areas would exist at the Site for cPAHs.

References

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